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(54) Printer and method of controlling it

(57) A printer comprises insertion means for inserting a printing medium to be printed by the printer; an interface (201) for connecting the printer to a host device (220); receiving means (202) for receiving data via said interface; interpreting means (203) adapted to recognize a print command and print data among the data received by said receiving means (202), to interpret the print command, and to determine that one of a front side and a back side of the printing medium that said print command indicates the print data is to be printed on; detection means (207) adapted to detect which one of said front and back sides of the printing medium is facing a predetermined direction; and control means for controlling the printer. The control means comprises comparing means (204) adapted to compare the printing medium side determined by said interpreting means (203) with that detected by said detection means; and printing means (204, 208) responsive to said comparing means (204) for printing said print data on the printing medium side detected by said detection means (207) when the printing medium sides compared by said comparing means (204) are the same.

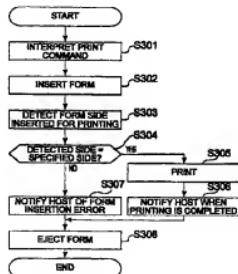


FIG.3

Description

[0001] The present invention relates to a printer for printing on cut-sheet type printing media. The invention further relates to a method of controlling the printer. More particularly, the present invention relates to a printer and its control method for handling a printing medium, such as a personal check, having machine-distinguishable front and back sides on which different information must be appropriately printed.

[0002] Printers for printing on such kind of specifically formatted printing media such as invoices, tickets, and personal or corporate checks, are widely available and commonly used (these printing media will simply be referred to as "forms" hereinafter). Typical of such printers are point-of-sale (POS) printers for printing sales receipts as well as customer checks received for payment. A typical check processing method used in a POS system is described below.

[0003] A POS system basically comprises a host device and a printer connected to this host. The printer comprises a print head for check printing and a MICR (Magnetic Ink Character Recognition) head for reading magnetic ink characters preprinted on the check.

[0004] The characters and print quality of MICR text conforms to known standards such as E13B or CMC7. MICR text is printed at a standardized location on the checks. When the MICR head passes over the MICR text, the text is detected and converted to an electrical signal. The waveform of the signal varies with each letter, thereby making it possible to interpret the signal to recognize and read the preprinted MICR text.

[0005] Check processing at the POS station includes printing the date, store name, and check amount on the check's front side, and printing a check endorsement and the store's bank account number on the check's back side. For simplicity below, these operations are hereinafter referred to as simply front-side printing and back-side printing.

[0006] Fig. 19 is a flow chart of a check processing method using a conventional printer configured to read MICR text when the check is inserted for back-side printing.

[0007] When a store clerk receives a check for payment from a customer, the clerk performs operations informing the host that payment via check is being received. This causes the host device to start check processing, and send a MICR text read command to the printer. The printer receives and interprets this read command, and waits for the check to be inserted (step S1901).

[0008] When the clerk inserts the check into the printer, the printer reads and recognizes the MICR text (step S1902), and sends the result to the host (step S1903). The host then determines whether the check is valid based on the information received from the printer. Check validation in this example can be simply accomplished by comparing the account number read from the

check with a database of invalid account numbers.

[0009] If the check is determined valid, the host sends the information for the front-side printing to the printer. Note that this information is hereafter referred to as the payment information. When the printer receives the payment information (step S1904), it advances the check to the printing start position of the print head (step S1905), prints (step S1906), and then ejects the printed check (step S1907).

5 [0010] The clerk then turns the check over and reinserts it into the printer. The printer again advances the check to the printing start position (step S1908). When the check is positioned, the host sends the information for the back-side printing, referred to as the endorsement information below, to the printer. The printer receives the endorsement information (step S1909), prints (step S1910), and ejects the printed check (step S1911). The clerk then hands the printed check to the customer for verification and signing, and receives the check back from the customer to complete the transaction.

10 [0011] Note that the order of printing on the front side and the back side of the check assumes the MICR reader and the print head to be positioned on the same 25 side of the path the check takes through the printer. If the MICR reader and the print head were on opposite sides of that path, the host would send the endorsement information in the first step and the payment information in the second step.

30 [0012] It will thus be obvious that a conventional printer of this type prints on both sides of a check or other form by printing data in the sequence they are received from the host, i.e., printing a first set of information on one side of the form, waiting for the operator to reverse and reinsert the form, and then printing a second set of information on the other side of the form.

35 [0013] Conventional printers of the type described above, however, are unable to determine whether the print data received from the host is to be printed on the front or the back of the form. The printer therefore prints

40 whatever data it receives from the host to whichever side of the form is inserted for printing, regardless of whether this is the correct side for the data received. This means that if the form is incorrectly inserted and positioned, the printing process will nevertheless be executed. The result is a wasted form.

45 [0014] Furthermore, while some printers have the print head and the MICR head positioned on the same side of the form transportation path, other printers have these heads on opposite sides of the form transportation path. The host must therefore change the sequence in which data is sent to the printer based on whether these heads are on the same or opposite sides of the path. That is, the host must be set up or switched to send either the information for front-side printing, i.e., the payment information in the above example, or the information for back-side printing, i.e., the endorsement information in the above example, first, and this further

complicates the printing process.

[0015] JP-U-3-70953/1991 discloses a printer provided with detection means for detecting the direction or orientation in which a printing medium has been inserted. The position and direction of the characters to be printed is determined in accordance with the detected direction. A printer with a similar function is disclosed in JP-A-61215077/1986. This known printer detects the orientation in which a form has been inserted by means of two detectors for detecting a magnetic stripe on a form to be printed.

[0016] JP-U-2-65559/1990 discloses duplex printer including a detector for detecting whether data received from a host is for single-side printing or duplex printing. In the latter case, the data are separated into front-side data to be printed on one side and back-side data to be printed on the other side. The front-side data and the back-side data are stored in respective buffer memories. Two printing mechanisms are provided for printing the front-side data to one side of a printing medium, and printing the back-side data to the other side of the printing medium, respectively.

[0017] JP-A-62-156790/1987 discloses a printer for printing airline tickets. The printer has a bar code detector to detect whether a correct form for the ticket to be printed has been inserted.

[0018] With consideration for the above-described problems, it is an object of the present invention to provide a printer for correctly printing data on a desired side of a printing form. It is a further object of the present invention to provide a control method for this printer.

[0019] These objects are achieved with a printer as claimed in claim 1, a method as claimed in claim 13 and a storage medium as claimed in claim 24.

[0020] With such printer and method it is possible to determine whether the side of a form inserted for printing matches the side of the form specified by a print command. As a result, desirable printing results can be achieved and wasting printing forms as a result of printing on the wrong side of the form can be prevented. Printer throughput and efficiency can therefore be improved.

[0021] Furthermore, the host device can easily control the printing process without the host device being switched or set to match a particular printer configuration.

[0022] Yet further, the printer operator can use the printer without concern for whether a form is inserted with one side facing a particular direction or whether the form is inserted with a particular edge leading through the form transportation path.

[0023] A printer according to the present invention preferably comprises detection means for detecting the edge orientation with which a printing medium is inserted to the printer, i.e., which of the form's edges is the leading edge, and a rotation means for rotating the print data if necessary based on the detected edge orientation.

[0024] When thus comprised, print data can be processed depending on both the form side and the lengthwise or widthwise edge orientation of the inserted form.

[0025] The form side and the lengthwise or widthwise edge orientation of the inserted form can be detected by detecting a specific mark on the printing medium. Exemplary marks include magnetic ink characters and bar codes. It is also possible to use a printing medium having one or more predetermined corners cut off. In this case the form side and the edge orientation can be detected by detecting the which corner(s) is cut off.

[0026] Preferably, the printer is controlled by means of a program controlled microprocessor. In that case, the control method can be provided by way of a storage medium storing a corresponding control program. Exemplary storage media include: semiconductor memory, CD-ROM, floppy disk, hard disk, magneto-optical disk, DVD-ROM and DVD-RAM disks, and magnetic tape. Such storage media can also be used to implement aspects of the present invention in existing printers. This control program can also be made available through a site on the World Wide Web, enabling users to download the program for use with existing printers.

[0027] Other objects and attainments together with a fuller understanding of the invention will become apparent and appreciated by referring to the following description of preferred embodiments taken in conjunction with the accompanying schematic drawings, in which:

Fig. 1 is a sectional view of a printer according to a first embodiment of the present invention;
35 Fig. 2 is a functional block diagram of the printer shown in Fig. 1;
40 Fig. 3 is a flow chart of a printing process in the printer shown in Fig. 1;
45 Fig. 4 is a sectional view of a printer according to a second embodiment of the present invention;
50 Fig. 5 is a flow chart of a printing process in the printer shown in Fig. 4;
55 Fig. 6 is a sectional view of a printer according to a third embodiment of the present invention;
Fig. 7 is a flow chart of a printing process in the printer shown in Fig. 6;
55 Fig. 8 is a flow chart of a printing process according to a fourth embodiment of the present invention;

Fig. 9 is a flow chart of a process performed by a host device during execution of the printing process according to the fourth embodiment of the present invention;

Fig. 10 is a functional block diagram of a printer according to a fifth embodiment of the present invention;

Fig. 11 is a flow chart of a printing process performed by a printer according to Fig. 10;

Fig. 12 and 13 are used to describe exemplary methods according to the present invention for detecting which side of a printing medium is facing a particular direction;

Fig. 14 to 16 are used to describe exemplary methods according to the present invention for detecting which side of a printing medium is facing a particular direction and with which edge as the leading edge the printing medium is inserted;

Fig. 17 is a functional block diagram of a printer according to a sixth embodiment of the present invention;

Fig. 18 is a flow chart of a printing process performed by a printer according to Fig. 17; and

Fig. 19 is a flow chart of a printing process for printing on both sides of a standardized form according to the prior art.

[0028] Throughout the figures like reference numerals denote like parts.

Embodiment 1

[0029] Fig. 1 is a sectional view of a printer according to a first embodiment of the present invention. This printer 10 comprises a main housing 101 having a control unit, an insertion opening 102 through which a form is inserted, an MICR reader 103, transportation rollers 104a to 104d, a print head 105 for printing on the form, a platen 106 opposite to the print head 105, and a form ejection mechanism 107 for passing the form out from the printer. The MICR reader 103 is disposed in proximity to the insertion opening 102 for reading MICR text preprinted on an inserted form.

[0030] Fig. 2 is a functional block diagram of a control unit 200 of printer 10. As shown in Fig. 2, control unit 200 comprises an input/output (I/O) interface 201, a data receiver 202, a data interpreter 203, a form side detector 207, a print buffer 206 for temporarily storing print data for a particular form side, a printing controller 208 for printing data stored in the print buffer 206, a data

transmitter 205, and a controller 204 for controlling various parts of the printer 10.

[0031] Control commands, print data, and other information are passed between the control unit 200 and the host 220 through the I/O interface 201. Control commands, print data, and other information are received through the I/O interface 201 by the data receiver 202, and the received data is then interpreted by the data interpreter 203. The form side detector 207 detects the form side, i.e., whether the form has been inserted with its front side or its back side facing a particular direction (simply referred to as "front-side up" and "back-side up" hereinafter even though the particular direction is not necessarily the upward direction). The data transmitter 205 passes the printer processing status to the host 220 via the I/O interface 201.

[0032] Fig. 3 is a flow chart of a printing process executed by printer 10. At the start of the printing process the data receiver 202 receives and interprets data received from the host 220 (step S301). The received data includes both a print command specifying a printing process, and print data. The print command contains information indicative of whether the print data sent after the print command is to be printed on the front or the back side of the form. It is to be noted that a print command indicating front-side printing is hereafter referred to as front-side printing command, and a print command indicating back-side printing is hereafter referred to as back-side printing command.

[0033] When a form is inserted into the insertion opening 102 (step S302), the form side detector 207 detects whether the form has been inserted front-side up or back-side up (step S303).

[0034] To accomplish this front-side/back-side detection, the inserted form is advanced by a transportation mechanism comprising transportation rollers 104a and 104b to a specific position at the MICR reader 103. The MICR reader 103 then attempts to scan the MICR text preprinted on the form front. If the MICR reader 103 successfully reads the text and captures a magnetic waveform, the magnetic waveform is sent to the form side detector 207. The form side detector 207 detects whether the form is front-side up or not based on whether a magnetic waveform is received from the MICR reader 103. That is, if the MICR reader 103 is able to read MICR text and thus capture a magnetic waveform from the form surface, the form has been inserted front-side up for printing on the front; if a magnetic waveform cannot be captured, the form has been inserted back-side up for printing on the back.

[0035] The controller 204 performs a printing process or error handling process based on the results supplied from the data interpreter 203 and the form side detector 207.

[0036] If the form side detected by the form side detector 207 is the same as that specified by the print command (step S304 returns YES), the following is performed in step S305: the print data is stored in the print

buffer 206; the form is advanced to a specific position at the print head 105 by the transportation mechanism; and the printing controller 208 then drives the print head 105 to print the print data stored in the print buffer 206 on the form. When printing is completed the printing controller 208 sends a printing completed signal to the controller 204. When the controller 204 receives this signal, it causes the data transmitter 205 to send a printing completed notice to the host 220 (step S306).

[0037] If the form side detected by the form side detector 207 is not the same as that specified by the print command (step S304 returns NO), the controller 204 sends an insertion error notice via the data transmitter 205 to the host 220 (step S307).

[0038] The form is then ejected (step S308) and the printing process ends once the controller 204 sends either the printing completed notice or the insertion error notice to the host 220. It is preferable that the form be ejected in different directions depending on whether the form was inserted appropriately and was successfully printed, or was incorrectly inserted and was not printed. For example, in the former case the form is preferably ejected through the form ejection mechanism 107, while in the latter case, the form is preferably ejected through the insertion opening 102. In this way the operator can easily determine whether the form was printed and the printing process completed normally, or whether the form must be reinserted and to be printed.

[0039] It is therefore possible by means of a printer according to this first embodiment of the present invention to achieve desired printing results without the host being aware of the specific printer configuration because the printer can determine whether the form side specified for printing by the print command and the form side inserted for printing are the same.

[0040] It is also possible to prevent wasting printing forms because the printing is not performed when the side of the form inserted for printing does not match the side required for printing by the print command.

Embodiment 2

[0041] Fig. 4 is a sectional view of a printer according to a second embodiment of the present invention. Printer 20 according to this second embodiment differs from printer 10 shown in Fig. 1 in that it comprises a form reversing mechanism 401 for reversing an inserted form such that front-side up becomes back-side up vice versa.

[0042] This form reversing mechanism 401 comprises first and second reversing paths 402, 403, and gates 404 to 406 for opening and closing the openings to path 402 and path 403. To reverse a form, gate 404 is operated to open the entrance to path 402. Gate 405 at this time blocks the entrance to path 403. The form is then moved into path 402 far enough that its trailing end is beyond gate 405. Gate 405 is then operated to open the entrance to path 403, and gate 406 is operated to

open the exit from path 403. After thus opening gates 405 and 406, the form is ejected through path 403 from its position inside path 402. The front and back sides of the form are thus reversed compared to the state in which the form was inserted.

[0043] Fig. 5 is a flow chart of an exemplary printing process executed by printer 20. Since the functional block diagram of Fig. 2 applies to printer 20 as well, the following description of Fig. 5 will also refer to Fig. 2.

10 [0044] When a form is inserted into the insertion opening 102 (step S501), the form side detector 207 detects whether the form has been inserted front-side up or not (step S502) as described above. The controller 204 then causes data transmitter 205 to send a form insertion notice to the host 220 (step S503). In response to this notice, the host 220 sends data to the printer 20. The data sent from the host 220 is received by the data receiver 202 of the printer 20 and interpreted by the data interpreter 203 (step S504). This data typically includes a print command for accomplishing a printing process, print data, and a form ejection command.

15 [0045] The controller 204 performs a printing process as described below based on the results supplied from the data interpreter 203 and the form side detector 207.

[0046] If the data interpreter 203 detects a print command in the data received from the host 220 (step S505 returns YES), print data contained in the data received from the host 220 is stored in the print buffer 206.

20 [0047] If the form side detected by the form side detector 207 is the same as that specified by the print command (step S506 returns YES), the form is advanced to a specific position at the print head 105 by the transportation mechanism. If the form side detected by the form side detector 207 is not the same as that specified by the print command (step S506 returns NO), the form is first inverted by the form reversing mechanism 401 (step S507), and subsequently advanced to that specific position.

25 [0048] The printing controller 208 then drives the print head 105 to print the print data stored in the print buffer 206 on the form (step S508). When printing is completed the printing controller 208 sends a printing completed signal to the controller 204. When the controller 204 receives this printing completed signal, it causes the data transmitter 205 to send a printing completed notice to the host 220 (step S509).

[0049] If the data interpreter 203 detects a form ejection command in the data received from the host 220 (step S510 returns YES), the form is ejected by the form ejection mechanism 107 (step S511).

[0050] If the data interpreter 203 does not detect a print command (a front-side or a back-side printing command) (step S505 returns NO) and no form ejection command (step S510 returns NO) in the data received from the host 220, the printing process is terminated because a command for a process other than a printing

process was received.

[0051] It is therefore possible by means of a printer according to this second embodiment of the present invention to prevent wasting print forms, improve printing efficiency, and achieve desired printing results without the host being aware of the specific printer configuration because the printer can determine whether the form side specified for printing by the print command and the side of the form inserted for printing are the same, and if they are not the same can automatically reverse the form so that the desired side of the form is presented for printing and then complete the printing process.

Embodiment 3

[0052] Fig. 6 is a sectional view of a printer according to a third embodiment of the present invention. Printer 30 according to this third embodiment differs from printer 10 shown in Fig. 1 in that it comprises two printing mechanisms. That is, in addition to print head 105 and platen 106, printer 30 comprises a print head 601 and a platen 602. As shown in the figure, print head 105 and print head 601 are disposed on opposite sides of the form transportation path.

[0053] Fig. 7 is a flow chart of an exemplary printing process executed by printer 30. It is to be noted that like steps in Fig. 5 and Fig. 7 are identified by like reference numerals, and further description thereof is omitted below. Also, since the functional block diagram of Fig. 2 applies to printer 30 as well, the following description of Fig. 7 will also refer to Fig. 2.

[0054] When a form is inserted and a print command is received (steps S501 to S505) as described above, the controller 204 performs a printing process as described below.

[0055] If the form side detected by the form side detector 207 is the same as that specified by the print command (step S508 returns YES), the form is advanced to a specific position at the print head 105 by the transportation mechanism. The printing controller 208 then drives the print head 105 to print the print data stored in the print buffer 206 on the form (step S701). If the form side detected by the form side detector 207 is not the same as that specified by the print command (step S506 returns NO), the form is advanced to a specific position at the print head 601. The printing controller 208 then drives the print head 601 to print the print data stored in the print buffer 206 on the form (step S702).

[0056] It is therefore possible by means of a printer according to this third embodiment of the present invention to prevent wasting print forms, improve printing efficiency, and achieve desired printing results without the host being aware of the specific printer configuration because the printer can automatically select which print head to use for the printing process based on which side of the form was inserted facing a particular direc-

tion.

Embodiment 4

5 [0057] Fig. 8 is a flow chart of an exemplary printing process according to a fourth embodiment of the invention. Fig. 9 is a flow chart of the related process performed by the host. It is to be noted that the control unit and configuration of a printer for executing the process 10 according to this fourth embodiment may be identical to those of printer 10 of the above-described first embodiment.

[0058] When a form is inserted into the insertion opening 102 of the printer 10 (step S801), the form side detector 207 detects whether the form has been inserted front-side up or not (step S802) as described above. The controller 204 then notifies the host 220 which side was detected by sending a form side notice (step S803). That is, if the form side detector 207 detects front-side up, the controller 204 sends a "front-side" notice, otherwise a "back-side" notice to the host 220.

[0059] When the host 220 receives such form side notice from the printer 10 (step S801), it detects 25 whether it is the front-side notice or the back-side notice (step S902). If a front-side notice is received (step S902 returns "FRONT"), the host 220 sends data for front-side printing to the printer 10 (step S903). However, if a back-side notice is received (step S902 returns "BACK"), the host 220 sends data for back-side printing to the printer 10 (step S904).

[0060] The printer 10 thus receives from the host 220 the print data appropriate for the form side detected in step S802, and stores the received print data in print buffer 206 (step S804). The printing controller 208 then drives the print head 105 to print the print data stored in print buffer 206 on the form (step S805), and then ejects the form by means of the form ejection mechanism 107 (step S806).

40 [0061] It is to be noted that if the form side desired for printing does not match the side indicated by the form side notice from the printer, the host can alternatively send a form ejection command instead of sending print data, and can notify the printer of a form insertion error.

[0062] It is therefore possible to achieve desired printing results with a printer and control method according to this fourth embodiment of the present invention because the printer detects and informs the host which side of the inserted form is facing a particular direction, and the host then sends print data for printing on the form front or back according to the notice received from the printer. By thus requesting print data corresponding to a specific side of the printing medium, desired printing results can be achieved even when the printing buffer capacity of the printer is limited.

Embodiment 5

[0063] Fig. 10 is a functional block diagram of a control unit 1000 of a printer according a fifth embodiment of the invention. This printer may be configured in the same way as printer 10 (Fig. 1) differing only with respect to the control unit. As shown in Fig. 10, control unit 1000 of the printer according to this fifth embodiment differs from control unit 200 of printer 10 in that it comprises first and second data buffer 1001 and 1002 for storing print data received from the host 220 for front-side printing and those for back-side printing, respectively. Depending on whether the form is inserted front-side up or back-side up, the print buffer 206 temporarily stores print data from either data buffer 1001 or data buffer 1002.

[0064] Fig. 11 is a flow chart of a printing process executed by the printer according to this fifth embodiment.

[0065] The data receiver 202 of the printer receives data from the host 220, and the data interpreter 203 then interprets the received data (step S1101). The controller 204 performs a printing process as described below based on the results supplied from the data interpreter 203.

[0066] If the data interpreter 203 detects a front-side data storage command (step S1102 returns YES), the controller 204 instructs the data transmitter 205 to send a request to start sending data to the host 220. When the host receives this start request, it begins sending the front-side data to the printer. The printer then stores the front-side print data received from the host 220 in data buffer 1001 (step S1103).

[0067] If the data interpreter 203 detects a back-side data storage command (step S1104 returns YES), the controller 204 sends a request to start sending data to the host 220. When the host receives this start request, it begins sending the back-side data to the printer. The printer then stores the back-side print data received from the host 220 in data buffer 1002 (step S1105).

[0068] If the data interpreter 203 detects a start printing command (step S1106 returns YES), the controller 204 is ready to start a printing process. This printing process is actually started by the form insertion (step S1107) and the form side detector 207 detecting whether the form is front-side up or back-side up (step S1108). Based on which side of the form is facing the particular direction, that is, up in this example, print data is copied from the corresponding one of the two data buffers 1001 and 1002 to the print buffer 206 (step S1109).

[0069] The printing controller 208 then drives the print head 105 to print the print data stored in the print buffer 206 on the form (step S1110). When printing is completed the printing controller 208 sends a printing completed signal to the controller 204. When the controller 204 receives this printing completed signal, it

causes the data transmitter 205 to send a printing completed notice indicative that the inserted side has been printed to the host 220 (step S1111). The form is then ejected by the form ejection mechanism 107 (step S1112).

[0070] It is to be noted that when print data is sent from the host 220 to the printer, the print data can be sent in conjunction with a data storage command. In this case the data receiver 202 buffers the print data while the data interpreter 203 interprets the data storage command.

[0071] It is further possible to send the storage command, the start printing command, and the print data simultaneously. In this case the data receiver 202 buffers the print data while the data interpreter 203 interprets the data storage command, the received print data is stored in either data buffer 1001 or data buffer 1002, and the start printing command is then executed.

[0072] By thus storing front-side print data and back-side print data in separate buffers and detecting whether the inserted form is front-side up or back-side up, a printer according to this fifth embodiment can selectively print data stored in the data buffer corresponding to the particular form side.

[0073] Furthermore, by storing print data in the printer, steps for sending data that is printed repeatedly can be eliminated, and printer throughput and efficiency can thus be improved.

[0074] It is to be noted that the preceding embodiments of the present invention have been described as using MICR text preprinted at a specific location on a form and an MICR text reader for detecting the form side. The invention is not limited to MICR text for this from side detection, however, and MICR text and an MICR reader can, for example, be replaced with a bar code and bar code reader, respectively.

[0075] It is further possible to differentiate form sides based on the shape of the form using any of the exemplary methods described below.

[0076] The preceding embodiments include means allowing the printer for distinguishing between the front side and the back side of an inserted form. Where the form side detection is based on a particular mark, such as MICR text or a bar code, at a predetermined location on one of the form sides (the front side in the embodiments), when the mark is detected, printing on that form side can be precisely positioned relative to the position of the mark. Printing on the opposite form side (the back side in the embodiments) cannot be ensured to be at a particular position because the form may have been inserted with the correct side up but not with the intended edge as the leading edge. Thus, the preceding embodiments of the invention are particularly suitable for printing forms where the print on the back side of the form may be at a more or less arbitrary location. This applies for instance to a check. While the payment information needs to be printed at prescribed positions on the front side of a check, there is no prescribed position

for the endorsement information on the check's back side. In the following, embodiments will be described that detect not only the form side but also the edge orientation of an inserted form. These embodiments are, therefore, capable of positioning the print precisely both on the front side and the back side of the form.

Exemplary methods for detecting a form side based on form shape

[0077] A printing medium suitable for detecting the form side based on the form's shape has, for example, the top left and bottom right corners, as viewed on the front side of the form, cut off like the form illustrated in Fig. 12. Whether a corner is cut off or not can be detected using, for example, a photodetector. In this way it is possible to determine both the form side, i.e., whether the form is inserted front-side up or back-side up, and the edge orientation, i.e., whether the form is inserted lengthwise or widthwise or with which of its four edges as the leading edge.

[0078] In Fig. 12, the form side detector 207 comprises a single detector disposed at position (A), that is, at a position corresponding to the left edge of an inserted form as seen in Fig. 12. Note that the stars in Fig. 12, like in those in Figures 13 to 16 explained later, indicate positions fixed relative to the form where it is checked whether the form is detected or, when the position of the star corresponds to the corner of the form and that corner is cut off, not detected.

[0079] In the example of Fig. 12, whenever a form is inserted into the printer the leading edge T of the form is detected by a form insertion detector not shown. The form is then advanced in the direction of arrow F by a preknown distance equal to the distance between the position of the form insertion detector and the position (A) of the form side detector. At this moment the form side detector either detects the form or does not detect it depending on whether the corresponding corner of the form is cut off. In the example in Fig. 12, if the form is inserted with the front side up, as shown on the left side in the figure, the form side detector will not detect the form at the leading edge T because the upper left corner is cut off (the upper one of the two stars will be in registration with the position (A)). The form will then again be advanced in the direction F until the form insertion detector detects the trailing edge B of the form and be further advanced by the preknown distance. At this moment the lower one of the two stars on the left side in Fig. 12 will be in registration with the position (A) of the form side detector. This time the form side detector detects the form since the corresponding edge is not cut off. As will be appreciated, if the form is inserted back-side up as shown on the right side of Fig. 12, the two detection results of the form side detector will be just opposite. Thus, the results of the detection can be used to detect the form side of an inserted form by referring to a table such as that shown in Fig. 12.

[0080] Fig. 13 shows an alternative embodiment in which the form side detector 207 comprises two detectors at positions (A) and (B), that is, at positions corresponding to the right and the left long edge of the form. Both positions are on one line extending perpendicular to the transport direction F of the form. In this case, when the form insertion detector detects a form, i.e., the leading edge T of the form, the form is advanced by the above mentioned preknown distance so that the left and right corners of the leading edge are just in registration with the positions (A) and (B), respectively, of the two detectors. The simultaneous detection results from these two detectors allow the same conclusion as those of the two successive detection events with a single detector in Fig. 12. Thus, a table same as that in Fig. 12 is established for the embodiment of Fig. 13 and can be used to determine whether the form is inserted front-side up or back-side up.

[0081] It is also possible using two detectors at positions (A) and (B) to determine both the form side and the edge orientation of the form as will be explained with reference to Fig. 14. In this case there are two successive detection events, each providing two detection results. In other words, the form is inserted and advanced in the same way as explained in conjunction with Fig. 12. Different from the case of Fig. 12, at each of the two measurement positions of the form, i.e., on the leading edge T and on the trailing edge B, there are two detection results, one from each of the two detectors (A) and (B). Compared to the case of Fig. 13, two locations at the leading edge and two locations at the trailing edge are successively brought into registration with the two respective detector positions. As will be easily understood from the explanation above, the table shown in Fig. 14 can be used to determine whether the form is inserted front-side up or back-side up and in each case whether it is inserted lengthwise or widthwise.

[0082] Fig. 15 illustrates a case that differs from the one explained with reference to Fig. 13 in that only one corner of the form is cut off (the top left corner, as seen on the front side, in the example shown). Depending on how the form is inserted, three different detection results are possible as listed in the table shown in Fig. 15. Thus, this embodiment allows to determine whether the form has been inserted front-side up or back-side up, and whether the upper edge or the lower edge is the leading edge.

[0083] Fig. 16 shows a further case differing from the case of Fig. 14 in that only one corner of the form is cut off and a third detector is provided, i.e., there are three detectors at positions (A), (B) and (C), all on the same line. Position (C) corresponds to the right edge of a form inserted widthwise as shown on the right side in Fig. 16. In this case, a set of three detection results is obtained at each of two successive detection events or measurements. Thus, the table shown in Fig. 16 is established and allows to determine the form side, i.e.,

front-side up or back-side up, and the edge orientation, i.e., which of the four edges a, b, c and d of the form is the leading edge T.

Embodiment 6

[0084] Fig. 17 is a functional block diagram of control unit 1700 of a printer according to a sixth embodiment of the invention. This printer may be configured in the same way as printer 10 (Fig. 1) differing only with respect to the control unit. As shown in Fig. 17, like control unit 1000 of the fifth embodiment, control unit 1700 comprises the two data buffers 1001 and 1002, and a rotation processor 1701. The form side detector in this embodiment is capable of detecting both the form side and the edge orientation of the inserted form as previously explained in conjunction with Fig. 16, for instance. Depending on the detected form side, the rotation processor 1701 reads print data from print data buffer 1001 or 1002; it then rotates the read data depending on the detected edge orientation. The rotated print data is stored in the print buffer 206 and printed.

[0085] Fig. 18 is a flow chart of an exemplary printing process executed by the printer according to this sixth embodiment. It is to be noted that like steps in Fig. 11 and Fig. 17 are identified by like reference numeral, and further description thereof is omitted below.

[0086] The printer of the sixth embodiment prepares for printing by means of steps S1101 to S1106 shown in Fig. 11. When a form is inserted (step S1107), the form side detector 207 determines whether the form side is front-side up or back-side up (step S1108). Based on which side of the form is facing the particular direction, that is, up in this example, print data is copied from the appropriate data buffer 1001 or 1002 to the rotation processor 1701 (step S1801).

[0087] The controller 204 then obtains the edge orientation of the form as detected by the form side detector 207, namely one of the orientations a, b, c, and d as shown in Fig. 16.

[0088] If the edge orientation is c (step S1802), the print data in the print data rotation processor 1701 is rotated clockwise 270° (step S1803) and then sent to the print buffer 206. If the edge orientation is d (step S1804), the print data in the print data rotation processor 1701 is rotated clockwise 180° (step S1805) and then sent to the print buffer 206. If the edge orientation is b (step S1806), the print data in the print data rotation processor 1701 is rotated clockwise 90° (step S1807) and then sent to the print buffer 206. If the edge orientation is a, the print data is sent to the print buffer 206 without having been rotated (0°).

[0089] The print buffer 206 temporarily stores the print data from the rotation processor 1701 (step S1808). The printing controller 208 then drives the print head 105 to print the print data stored in the print buffer 206 on the form (step S1110). When printing is completed the printing controller 208 sends a printing com-

pleted signal to the controller 204. When the controller 204 receives this printing completed signal, it causes the data transmitter 205 to send a printing completed notice to the host 220 (step S1111). The printed form is then ejected by the form ejection mechanism 107 of the printer (step S1112).

[0090] It will also be obvious that while this exemplary embodiment of the invention is described as rotating by 0°, 90°, 180° or 270° to allow for four possible edge orientations, text can alternatively be rotated by other angles. Furthermore, text can be rotated clockwise as noted above, counterclockwise, or a combination of both to desirably shorten the data processing time.

[0091] It is therefore possible by means of a printer according to this sixth embodiment of the present invention to achieve desirable printing results by storing print data for front-side printing and print data for back-side printing in separate data buffers, and rotating the print data according to the edge orientation of the inserted form.

[0092] Although the present invention has been described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. For example, the present invention has been described with reference to a printer in which the print head and MICR head are disposed to the same side of the form transportation path such that when a form is inserted front-side up, data is printed on the front side of the form. It will be obvious, however, that the print head and MICR head can be disposed on opposite sides of the form transportation path such that when a form is inserted front-side up, data is printed on the back side of the form.

Claims

40. 1. A printer comprising:

insertion means for inserting a printing medium to be printed by the printer;
 connection means (201) for connecting the printer to a host device (220);
 receiving means (202) for receiving data via said connection means;
 interpreting means (203) adapted to recognize a print command and print data among the data received by said receiving means (202), to interpret the print command, and to determine that one of a front side and a back side of the printing medium that said print command indicates the print data is to be printed on;
 detection means (207) adapted to detect which one of said front and back sides of the printing medium is facing a predetermined direction; and

control means for controlling the printer, the control means comprising

comparing means (204) adapted to compare the printing medium side determined by said interpreting means (203) with that detected by said detection means (203) with that detected by said detection means (207); and

printing means (204, 208) responsive to said comparing means (204) for printing said print data on the printing medium side detected by said detection means (207) when the printing medium sides compared by said comparing means (204) are the same.

2. The printer as set forth in claim 1, wherein the control means further comprises:

ejection means for ejecting a printing medium when the printing medium sides compared by said comparing means (204) are not the same.

3. The printer as set forth in claim 2, wherein said insertion means comprises an insertion opening (102), the printer further comprises an ejection opening, and said control means further comprises means, responsive to said printing means having completed printing said print data, for ejecting the printing medium through said ejection opening, and responsive to said comparing means (204) for ejecting the printing medium through said insertion opening (102) when the printing medium sides compared by said comparing means (204) are not the same.

4. The printer as set forth in claim 1, further comprising a reversing mechanism (401) adapted to turn an inserted printing medium from one of said front and back sides over to the other side;

wherein the control means comprises means (204) responsive to said comparing means (204) for causing the reversing means (401) to turn over a printing medium to the other side when the printing medium sides compared by said comparing means are not the same, and said printing means (208) is responsive to said reversing means having turned over the printing medium for printing said print data on said other side of the printing medium.

5. The printer as set forth in claim 1, further comprising

a first printing unit (105, 106) configured to print print data on one of said front and back sides of a printing medium, and

a second printing unit (601, 602) configured to print print data on the other one of said front and back sides;

wherein the control means comprises means (204) responsive to said comparing means (204) for selecting said first printing unit to print said print data on said one printing medium side when the two printing medium sides compared by said comparing means are the same, and for selecting said second printing unit to print said print data on the said other printing medium side, otherwise.

6. The printer as set forth in claim 1, further comprising

sending means (205) responsive to said detection means (207) for sending via said connection means (201) a notification indicative of the printing medium side detected by the detection means (207),

wherein said control means comprises means (204) responsive to said sending means having sent said notification for causing said printing means (208) to print print data received by said receiving means in response to said notification on the printing medium side detected by said detection means (207).

7. The printer as set forth in claim 1, further comprising:

a first data buffer (1001) configured to store print data to be printed on the front side of said printing medium, and

a second data buffer (1002) configured to store print data to be printed on the back side of said printing medium;

wherein said printing means (204, 208) is responsive to said detection means (207) for printing the print data stored in said first data buffer (1001) or that stored in said second data buffer (1002) when said detection means (207) detects said front side or said back side, respectively.

8. The printer as set forth in any one of the preceding claims, wherein said detection means (207) is means for detecting a particular mark on the printing medium.

9. The printer as set forth in claim 8, wherein said detection means (207) is a magnetic ink character reader or a bar code reader.

10. The printer as set forth in any one of the preceding claims, wherein said detection means (207) includes side detection means for detecting said printing medium side, and edge detection means for detecting the edge orientation of the printing medium by detecting which of predefined edges is

the leading edge of said printing medium, and said control means further comprises data rotation means (1701) responsive to said edge detection means for rotating said print data based on the detected edge orientation. 5

11. The printer as set forth in any one of the preceding claims wherein said control means is implemented as a program controlled microprocessor 10

12. Use of the printer as defined in claim 10 or 11 for printing on a printing medium having one or more predetermined ones of its corners cut off, wherein said side detection means (207) and said edge detection means detect the printing medium side and the edge orientation, respectively, by detecting the location of said one or more cut-off corners. 15

13. A method of controlling a printer connected to a host device (220) so as to print on at least one of the front side and the back side of a printing medium based on data received from the host device, comprising: 20

(a) receiving data from the host device (220);
 (b) recognizing print data and a print command among the data received in step (a);
 (c) interpreting said print command and determining that one of said front and back sides of the printing medium that said print command indicates the print data is to be printed on; 25
 (d) detecting which one of said front and back sides of a printing medium inserted into the printer is facing a particular direction;
 (e) comparing the printing medium side determined in step (c) with that detected in step (d);
 (f) printing said print data on the printing medium side detected in step (d) when the two printing medium sides compared in step (e) are the same. 30

14. The method as set forth in claim 13, further comprising: 35

(g) ejecting an inserted printing medium when step (e) reveals that the two printing medium sides are not the same. 40

15. The method as set forth in claim 14, further comprising: 45

(h) ejecting the printing medium, following step (f), at a first location of the printer, wherein step (g) comprises ejecting the printing medium at a second location of the printer different from said first location. 50

16. The method as set forth in claim 13, wherein step (f) comprises: 55

(f1) turning the inserted printing medium from that one of said front and back sides detected in step (d) over to the other side if the two printing medium sides compared in step (e) are not the same; and
 (f2) printing said print data on said other printing medium side. 60

17. The method as set forth in claim 13, wherein step (f) comprises: 65

(f3) printing print data on one of said front and back sides of a printing medium, and
 (f4) printing print data on the other one of said front and back sides of the printing medium; and
 (f5) selecting step (f3) when the two printing medium sides compared in step (e) are the same, and selecting step (f4), otherwise. 70

18. The method as set forth in claim 13, further comprising: 75

(i) sending to the host device a notification indicative of the printing medium side detected in step (d); and
 (j) receiving from the host device (220) print data corresponding to the printing medium side detected in step (d). 80

19. The method as set forth in claim 13, further comprising: 85

(k) storing print data determined in step (c) to be printed on the front side of a printing medium in a first data buffer (1001); and
 (l) storing print data determined in step (c) to be printed on the back side of the printing medium in a second data buffer (1002); wherein step (f) prints, depending on the printing medium side detected in step (d), either the data stored in said first data buffer or that stored in said second data buffer. 90

20. The method as set forth in any one of claims 13 to 19, wherein step (d) decides one or the other of said front and back sides as facing said particular direction depending on whether or not a particular mark on said printing medium is detected. 95

21. The method as set forth in claim 20, wherein step (d) comprises detecting magnetic ink characters or a bar code as said particular mark. 100

22. The method as set forth in any one of claims 13 to 105

21, further comprising

- (m) detecting the edge orientation of an inserted printing medium by detecting which of predefined edges is the leading edge of said printing medium, and
- (n) rotating said print data in accordance with the edge orientation detected in step (m).

23. The method as set forth in claim 22 applied to a printing medium having one or more predetermined ones of its corners cut off, wherein step (d) detects the printing medium side and step (m) detects the edge orientation by detecting the location of said one or more cut-off corners. 10 15

24. A machine readable data storage medium carrying a computer program that, when executed in a printer according to claim 11 implements a method as defined in any one of claims 13 to 23. 20

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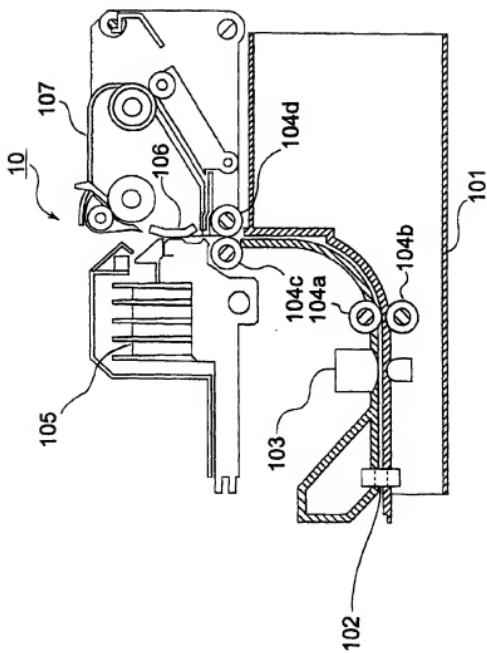


FIG.1

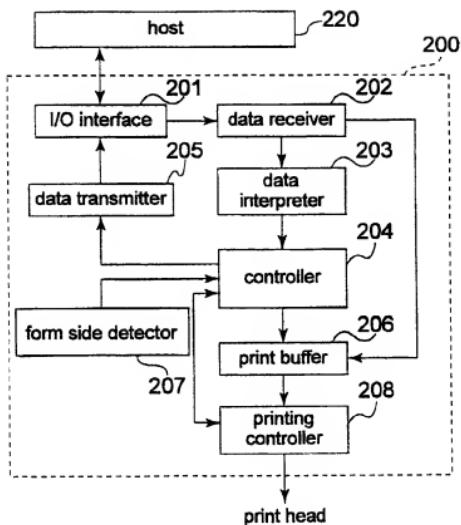


FIG.2

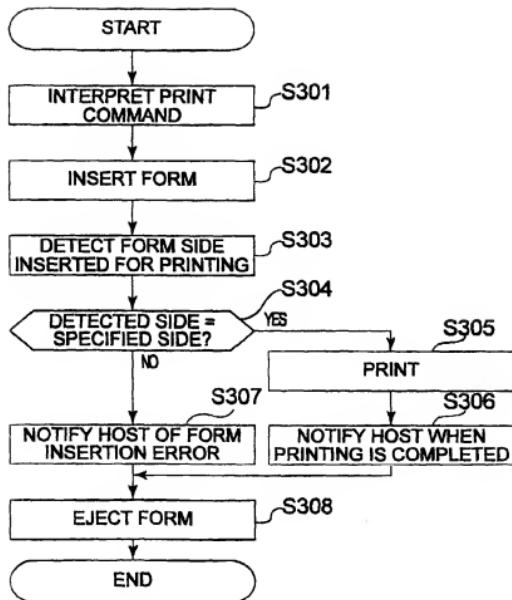


FIG.3

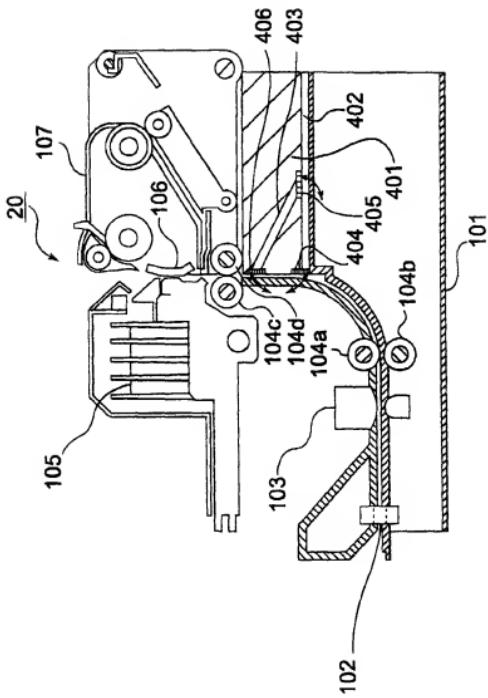


FIG.4

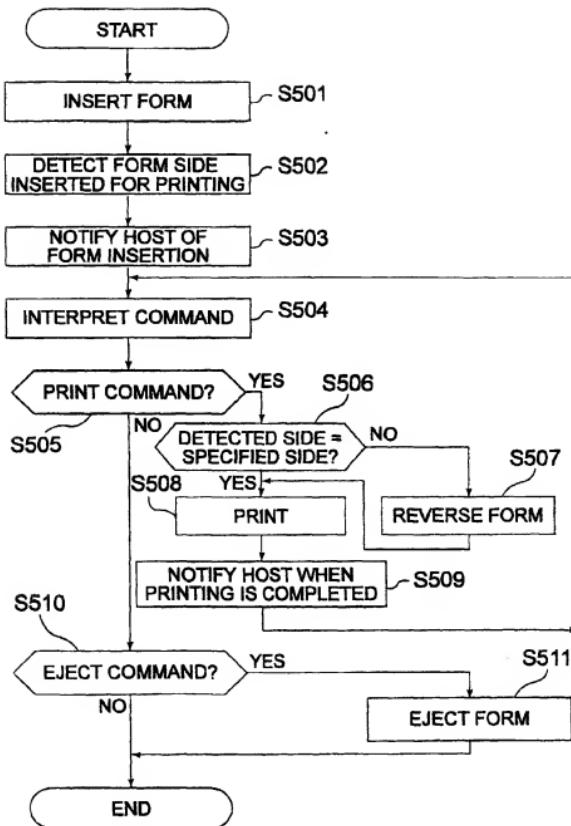


FIG.5

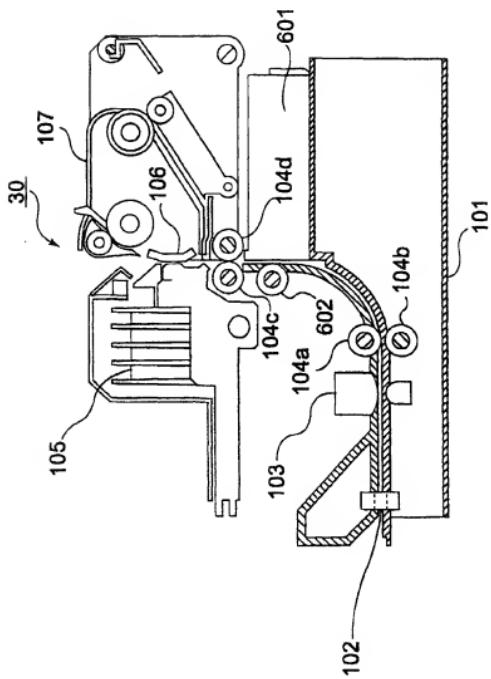


FIG.6

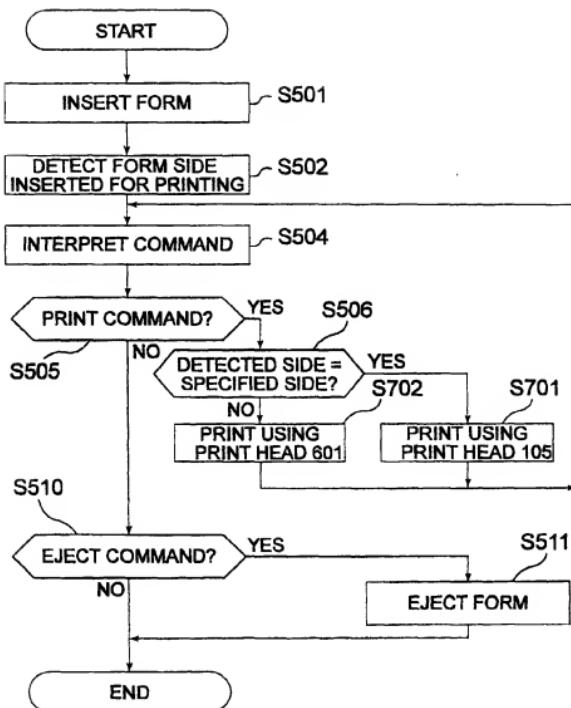


FIG.7

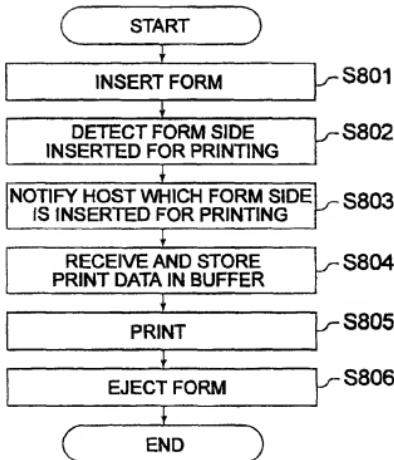


FIG.8

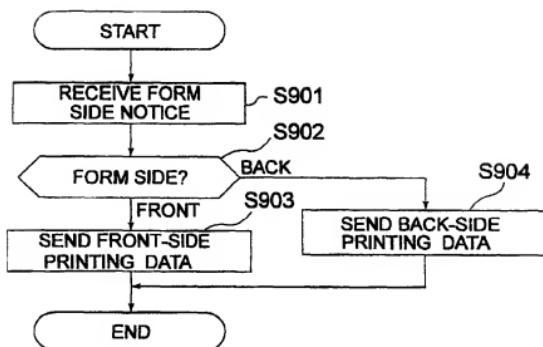


FIG.9

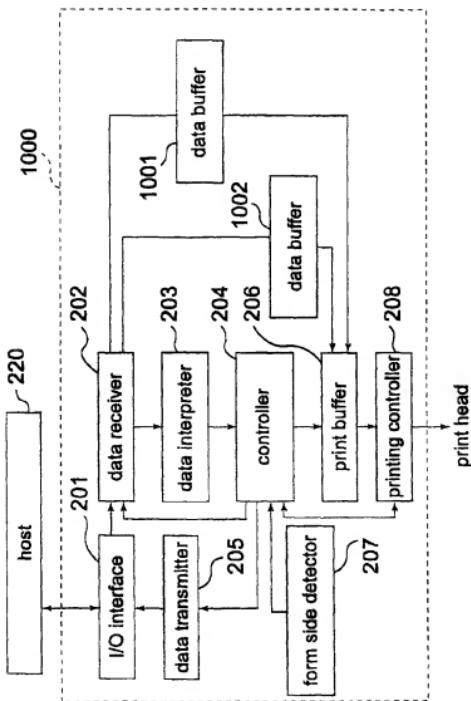


FIG.10

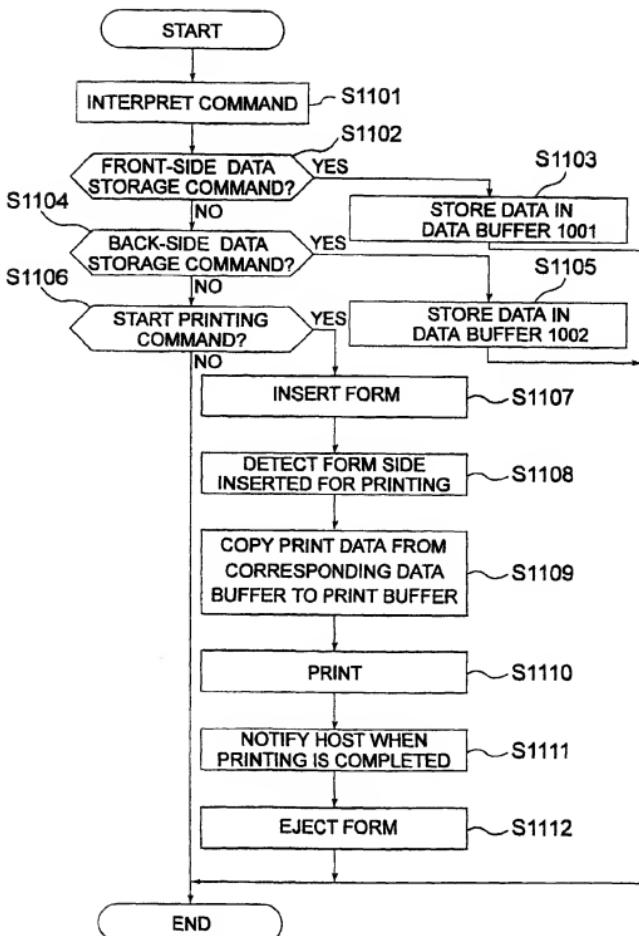


FIG.11

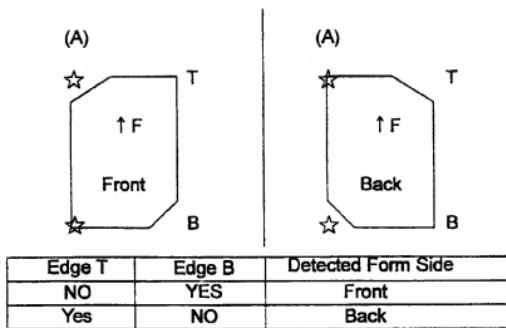
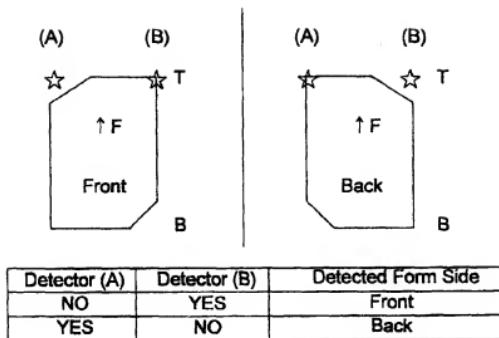
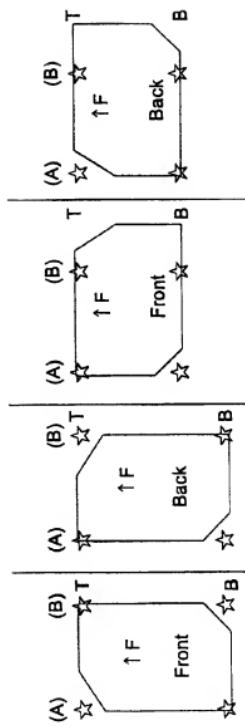


FIG.12



[YES: Form detected / NO: Form not detected]

FIG.13



Detector (A)		Detector (B)		Detected Form Side / Orientation
Edge T	Edge B	Edge T	Edge B	
NO	YES	YES	NO	Front / Lengthwise
YES	NO	NO	YES	Back / Lengthwise
YES	NO	YES	YES	Front / Widthwise
NO	YES	YES	YES	Back / Widthwise

[YES: Form detected / NO: Form not detected]

FIG.14

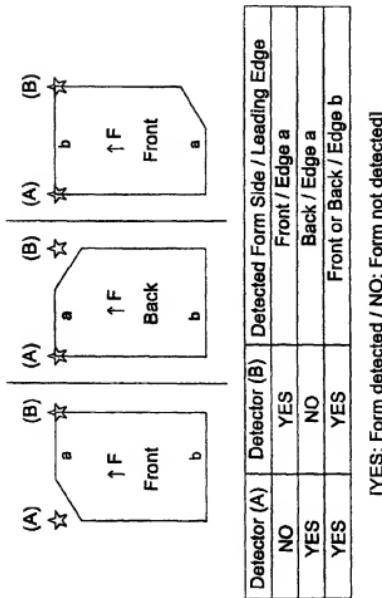
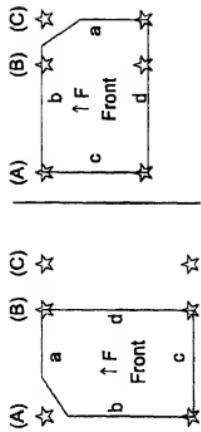


FIG.15



Leading Edge Detector			Trailing Edge Detector			Detected Form Side / Leading Edge		
(A)	(B)	(C)	(A)	(B)	(C)	Front / Edge a	Front / Edge b	Front / Edge c
NO	YES	NO	YES	YES	NO	YES	NO	NO
YES	YES	NO	YES	YES	YES	NO	NO	NO
YES	YES	NO	YES	NO	NO	YES	YES	YES
YES	YES	YES	NO	YES	YES	NO	NO	NO
YES	NO	NO	YES	YES	NO	NO	NO	NO
NO	YES	YES	YES	YES	YES	YES	YES	YES
YES	YES	NO	NO	YES	NO	NO	NO	NO
YES	YES	YES	YES	YES	NO	NO	NO	NO

[YES: Corner of Form detected / NO: Corner of Form not detected]

FIG.16

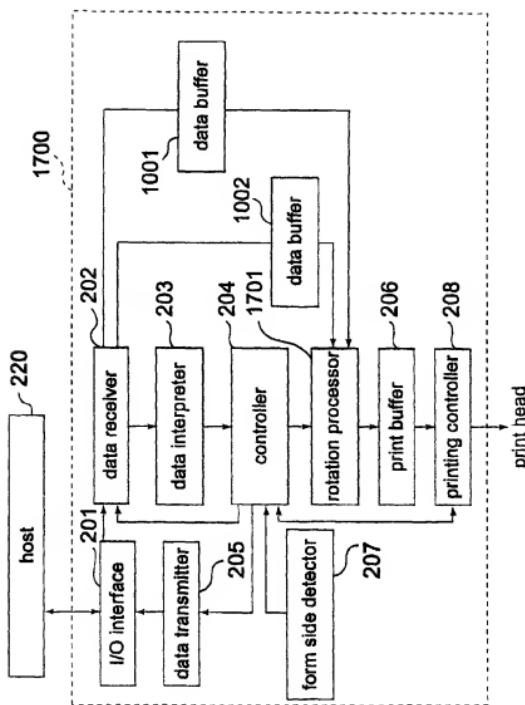


FIG.17

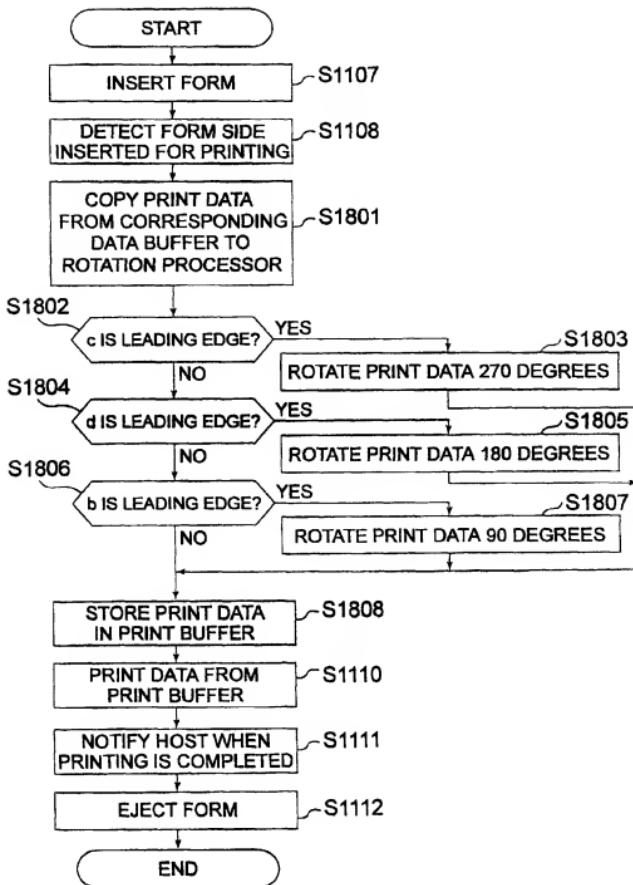


FIG.18

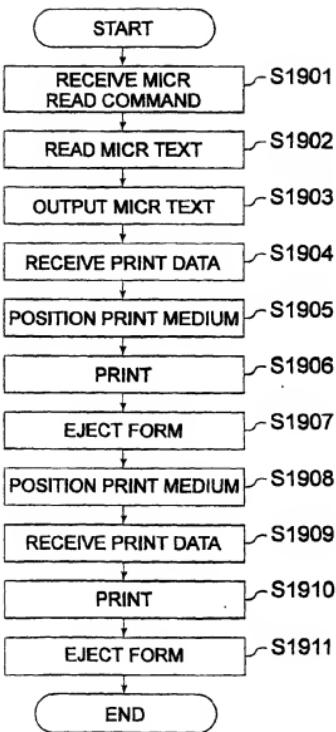


FIG.19